

New Hampshire Volunteer River Assessment Program

2000

SUGAR RIVER

Water Quality Report



February 2003

STATE OF NEW HAMPSHIRE
Volunteer River Assessment Program
2000
SUGAR RIVER
Water Quality Report

*STATE OF NEW HAMPSHIRE
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1. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

VRAP (“vee-rap”) supports watershed organizations in their efforts to monitor river water quality. The primary focus of VRAP is to provide volunteers with river monitoring guidelines, equipment loans, and technical training. DES also incorporates applicable volunteer monitoring results into its evaluation of New Hampshire surface waters. Annual reports for each VRAP river include a summary of monitoring results and recommendations for future water quality sampling. VRAP aims to foster public understanding and stewardship of river systems and to increase available water quality information about New Hampshire rivers and streams.

VRAP loans and maintains water monitoring kits that include meters and supplies for on-station measurement of five basic water quality parameters: water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. The investigation of these and additional parameters such as nutrients, metals, and *E. coli* is conducted by state water quality personnel and may be augmented by volunteer sampling. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results meeting DES Quality Assurance and Quality Control (QA/QC) requirements supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

VRAP typically recommends sampling every other week during the summer, and citizen monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. Training sessions are typically conducted outdoors near surface waters for an interactive demonstration. During the training volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory

analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteer organizations forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

Applicable volunteer data are input to a water quality database, and considered (along with other reliable sources of data) during periodic DES water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act.

More than fifty VRAP volunteers sampled five rivers regularly during the year 2000. VRAP 2000 rivers include the Sugar, Lamprey, Exeter, Cocheco, and Baker Rivers, as well as preliminary sampling on several additional rivers and streams. These accomplishments were made possible by the hard work and dedication of citizen volunteers and many additional people who helped to plan, support, and carry out these monitoring efforts.

2. PROJECT SUMMARY: SUGAR RIVER VRAP 2000

Water quality monitoring of the Sugar River by the volunteers included in the VRAP began in 2000. Water samples were collected from sites on the mainstem and tributaries throughout the watershed. The volunteers were not only interested in the core VRAP water quality monitoring parameters, but were also interested in determining the concentrations of arsenic, total phosphorus, and biochemical oxygen demand (BOD).

During 2000, sampling was focused on 9 stations along the river and tributaries, including the towns of Sunapee, Newport, and Claremont. Samples were collected every two weeks during April through September, and approximately monthly from October through December.

3. RESULTS, DISCUSSION, AND RECOMMENDATIONS

This section includes a description of the Sugar River VRAP 2000 monitoring locations and results, a discussion of the results in comparison with New Hampshire water quality standards, and recommendations for future sampling and watershed investigations. The VRAP monitoring locations, "stations", are discussed from upstream to downstream (Appendix A). Each station is described by a map and by a narrative station description submitted by volunteers. Results are presented in graphs and text prepared by the VRAP, and tables including all monitoring results from each station are located in Appendix B.

The discussion of the results includes recommendations for future sampling and investigations that will contribute to the assessment of water quality conditions.

The water quality information collected at each station is summarized in a table that provides the reader with an overview of the monitoring activities and results. The table can be used as a quick reference for the reader; results not meeting state water quality criteria do not necessarily indicate a violation of water quality standards. The summary table indicates: (1) the number and type of samples collected, (2) the number of samples collected according to quality assurance and quality control requirements, (3) the number of samples not meeting state water quality criteria, (4) the range of the measurements, and (5) abbreviated water quality standards.

The presentation and discussion of the volunteer results focuses primarily on three parameters: DO, temperature, pH, and *E. coli*. These parameters are the core of the VRAP monitoring system, and have relatively straightforward standards that lend themselves to the assessment of individual results. These results can contribute directly to the determination of fishable and swimmable river and stream conditions, which is often a primary volunteer monitoring goal. This section includes graphs of dissolved oxygen (DO) concentrations with water temperature, and *E. coli* bacteria results (if collected). Please see Appendix C for descriptions of the water quality parameters analyzed under VRAP during 2000 and the associated New Hampshire surface water quality standards (SWQS) for Class B waters.

The reader should note that discussion is limited to those parameters at each station that do not meet state criteria. For example, since pH is the only parameter at 19-Sgr that exceeded state criteria, only pH will be discussed in detail. However, recommendations are not limited to parameters with results that fall outside state criteria.

VRAP aims to provide a mechanism for citizens to contribute to the ongoing process of surface water quality assessment. Recommendations for future monitoring activities and watershed investigations are included in this report following the results and discussion. Also included are recommendations for improvements in sampling techniques to encourage volunteers to adhere to quality assurance and control measures.

Volunteers are encouraged to sample their rivers and streams on a long-term basis. Much of the information volunteers collect profiles river and stream locations for the first time. Several (five to ten) years of good quality measurements will be needed to begin to decipher water quality trends and the status of rivers and streams relative to the New Hampshire surface water quality standards. Water quality data from the stretch of river sampled by volunteers are presented in graphs in Appendix D. These graphs are included in the report to show how water quality conditions change from upstream to downstream. The current report format will describe water quality conditions on a station-by-station basis.

All results generated by the Sugar River VRAP 2000 were collected using the VRAP Field Datasheet and Field Sampling Protocols, 2000 (see Appendix E).

3.1. 19-Sgr: Route 11 Bridge, Sunapee, NH

3.1.1. Station Description

19-Sgr is located on a main road, a half-mile from its source, Lake Sunapee (Figure 1). The lake is surrounded by numerous summer and year round homes and attracts many recreational boaters. A small gas station is located just upstream of the station. The riverbanks show signs of erosion and the riverbed is made of cobble stones.

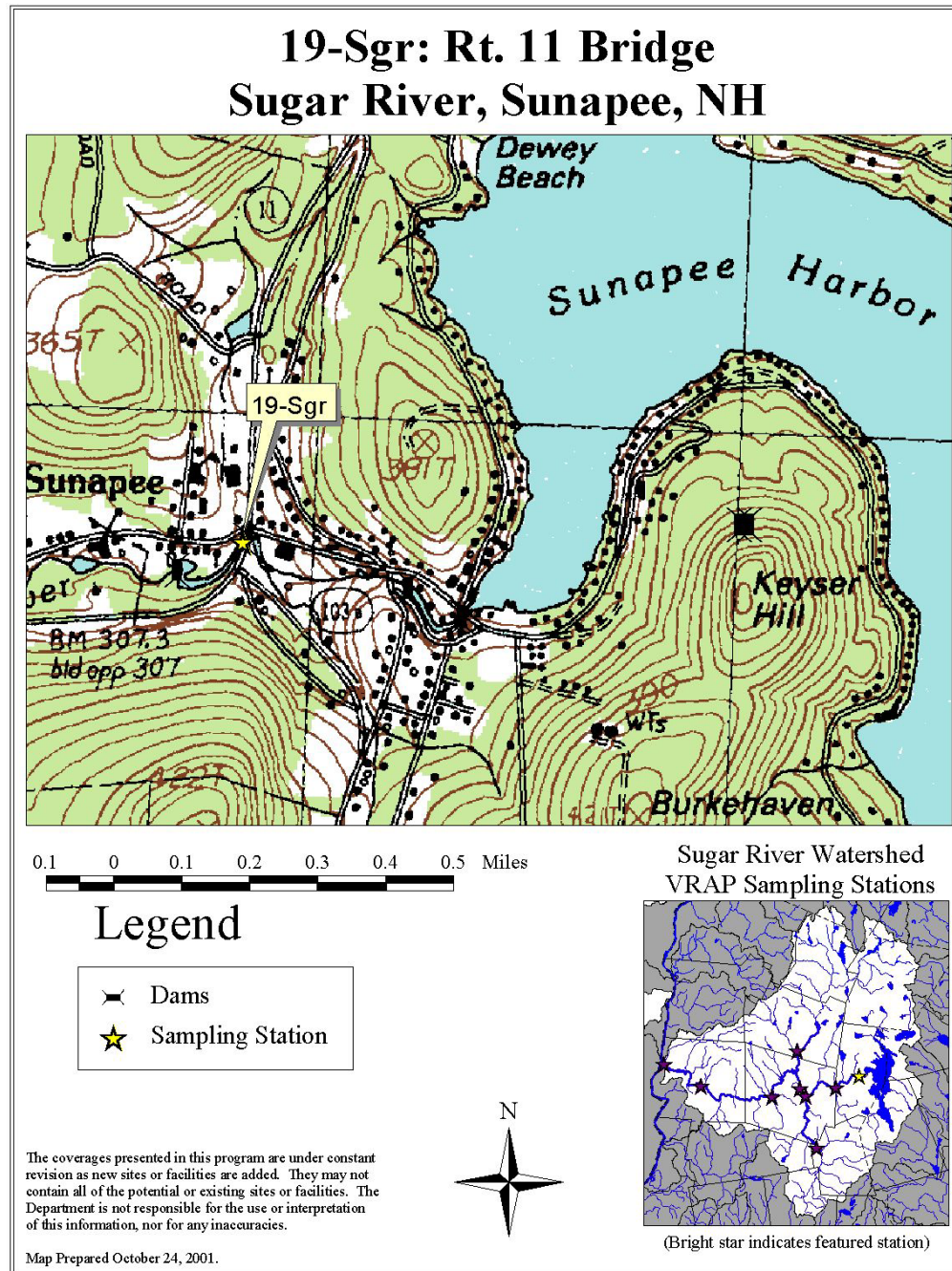


Figure 1. Station location map for 19-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.1.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 1). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Ten pH measurements were below the Class B Water Quality Standard.

Table 1. Monitoring Summary: 19-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.92 - 13.02	>5
DO (% sat)	13	13	0	81.9 - 96.8	>75
pH (Std. Units)	12	12	10	5.22 - 6.76	6.5-8.0
Turbidity (NTU)	13	13	0	0.35 - 1.3	<10 above background
Conductivity (µmho/cm)	12	12	0	57.6 - 98.4	NA
<i>E. coli</i> (CTS/100mL)	12	12	0	0 - 90	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.45	NA
NO ₃ (mg/L)	2	2	0	<0.001 - <0.05	NA
Arsenic (mg/L)	4	4	0	<0.05	<0.34
Alkalinity (mg/L)	13	13	0	0.4 - 35	NA
BOD (mg/L)	11	11	0	6 - 9.52	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 2 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

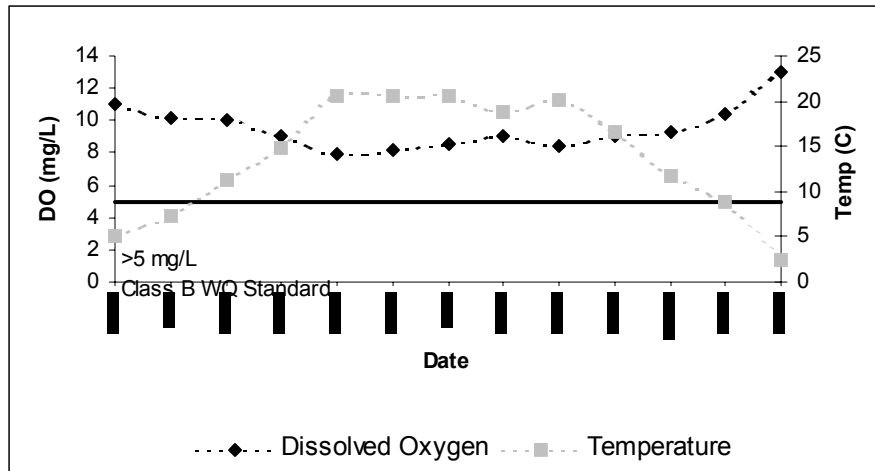


Figure 2. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 19-Sgr. Route 11 Bridge, Sunapee, NH. VRAP, Year 2000.

pH

The pH at this location, ranging from 5.22 to 6.76, was measured below the state standard range on ten of twelve monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

E. coli

E. coli levels were well below the standard during the summer of 2000 (Figure 3). Local watershed volunteers collected “instantaneous” samples for *E. coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

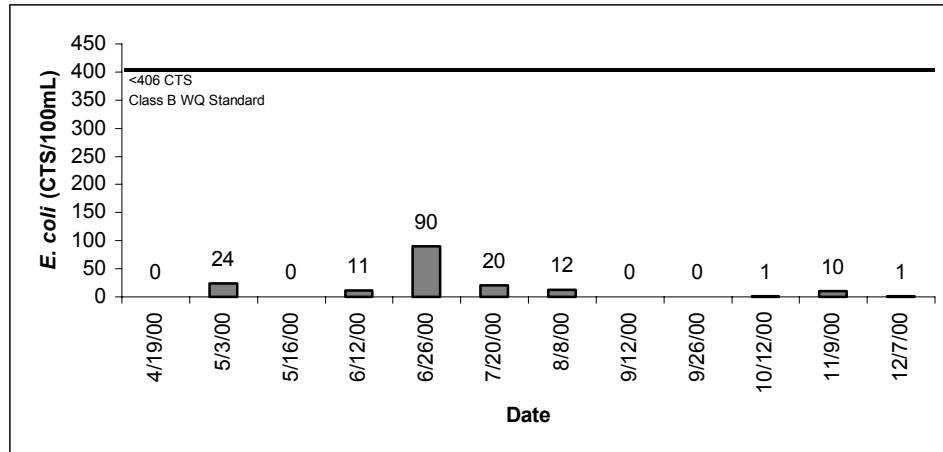


Figure 3. *E. coli* Bacteria Counts. Sugar River at 19-Sgr. Route 11 Bridge, Sunapee, NH. VRAP, Year 2000.

3.1.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- ***E. coli*:** Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.2. 16-Sgr: Route 103 Bridge, Sunapee, NH

3.2.1. Station Description

16-Sgr is located directly below a double culvert and discharge pipe at the intersection of two main roads (Figure 4). At this point the river has flowed from 19-Sgr through a forested and residential area and underneath an old railroad yard. The river is contained by culverts and has a boulder riverbed.

16-Sgr: Rt. 103 Bridge Sugar River, Sunapee, NH

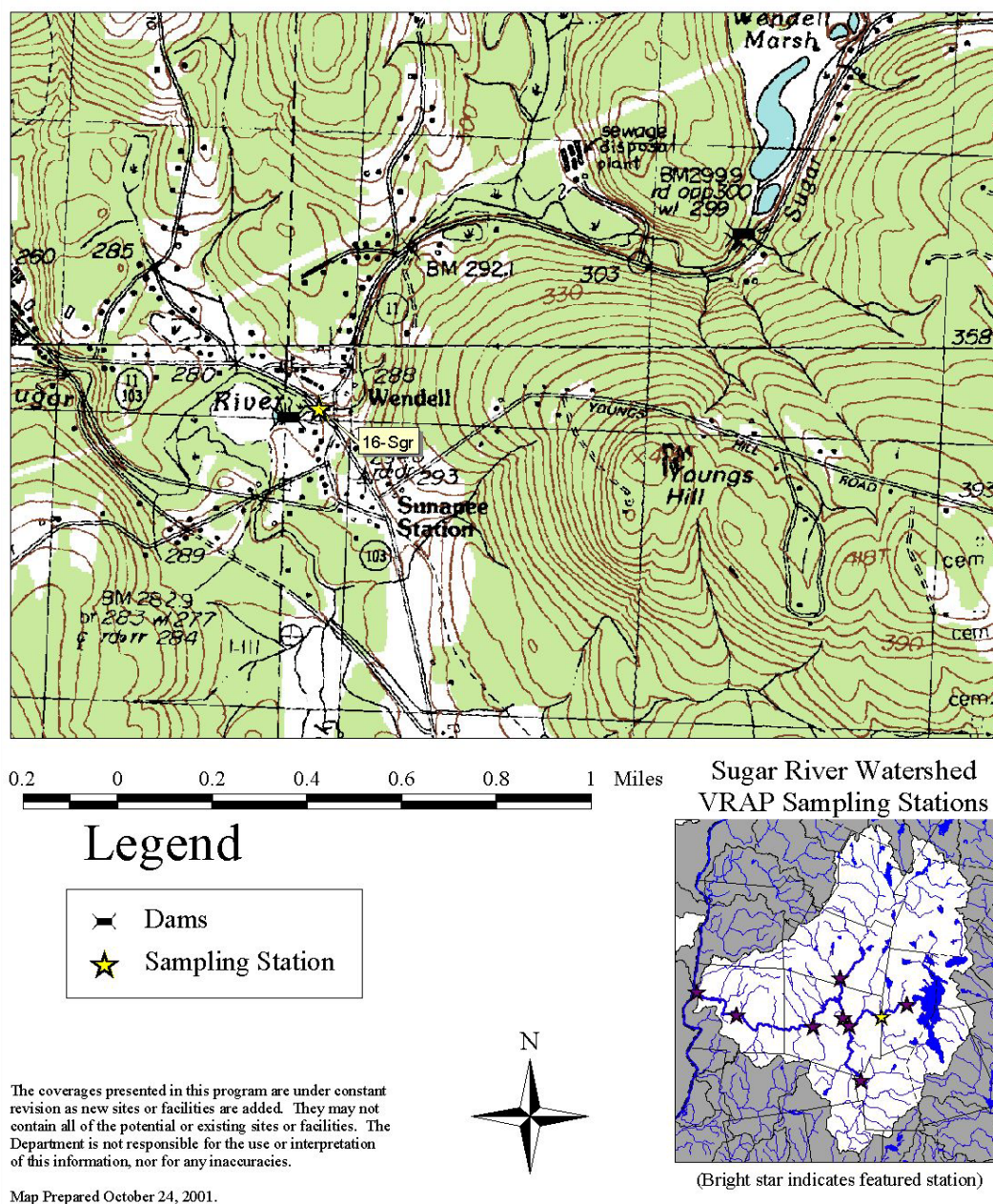


Figure 4. Station location map for 16-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.2.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 2). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples

met the Quality Assurance and Quality Control (QA/QC) requirements. Ten pH measurements were below the Class B Water Quality Standard.

Table 2. Monitoring Summary: 16-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.73 - 13.83	>5
DO (% sat)	13	13	0	83.8 - 95.2	>75
pH (Std. Units)	12	12	10	5.25 - 6.65	6.5-8.0
Turbidity (NTUs)	13	13	0	0.45 - 2.5	<10 above background
Conductivity (µmho/cm)	12	12	0	40.02 - 105.6	NA
<i>E. coli</i> (CTS/100mL)	12	12	0	0 - 295	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.58	NA
NO₃ (mg/L)	1	1	0	<0.001	NA
Arsenic (mg/L)	5	5	0	<0.005 - 0.2	<0.34
Alkalinity (mg/L)	13	13	0	0 - 26.2	NA
BOD (mg/L)	12	12	0	4.15 - 8.92	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 5 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

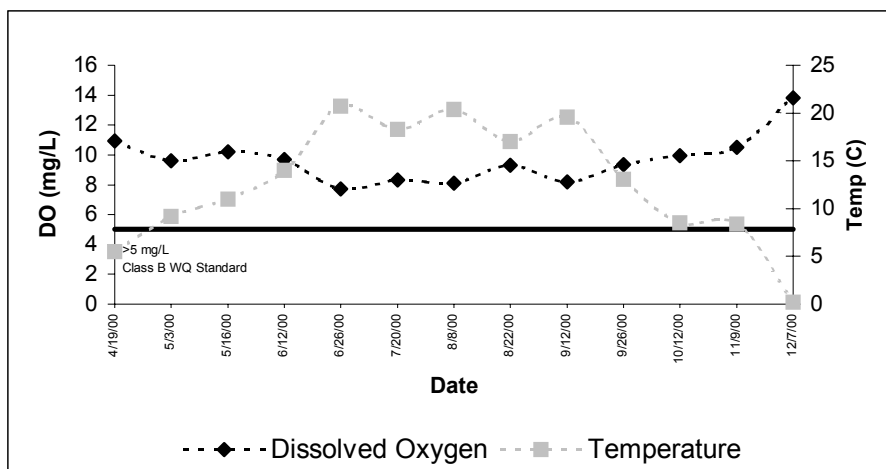


Figure 5. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 16-Sgr. Route 103 Bridge, Sunapee, NH. VRAP, Year 2000.

pH

The pH at this location, ranging from 5.25 to 6.65, was measured below the state standard range on ten of twelve monitoring dates. The precision of the VRAP pH meters (± 0.02) requires that results within 0.02 of the standard range (6.5 to 8.0) are not considered out of range. For example, a reading of 6.48 is considered within range, while a reading of 6.47 falls below the standard range.

Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

E. coli

Figure 6 shows the *E. coli* counts during summer 2000. Local watershed volunteers collected “instantaneous” samples for *E. coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

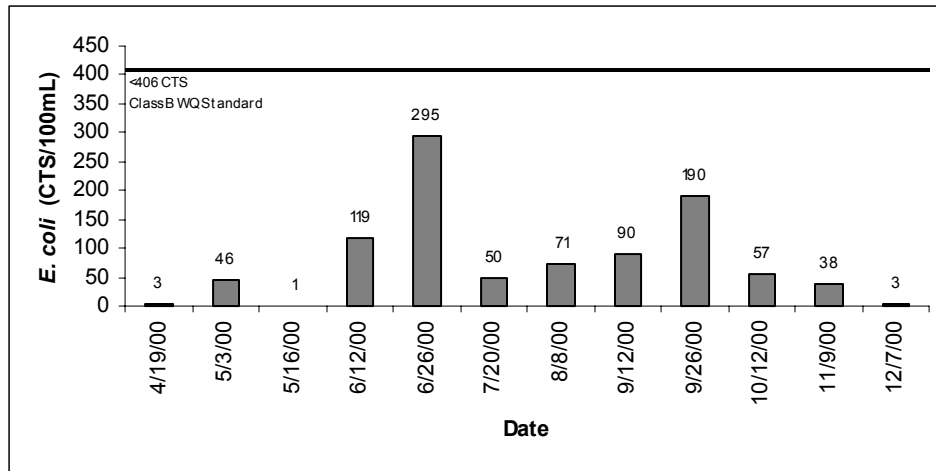


Figure 6. *E. coli* Bacteria Counts. Sugar River at 16-Sgr, Route 103 Bridge, Sunapee, NH. VRAP, Year 2000.

3.2.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- *E. coli*: Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is

imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.3. 12-Sgr: Route 10 Bridge, Newport, NH

3.3.1. Station Description

Located in downtown Newport, 12-Sgr is downstream of an impoundment, a suburban residential area, and old brick buildings (Figure 7). The silt and cobble riverbed is highly eroded on the right bank.

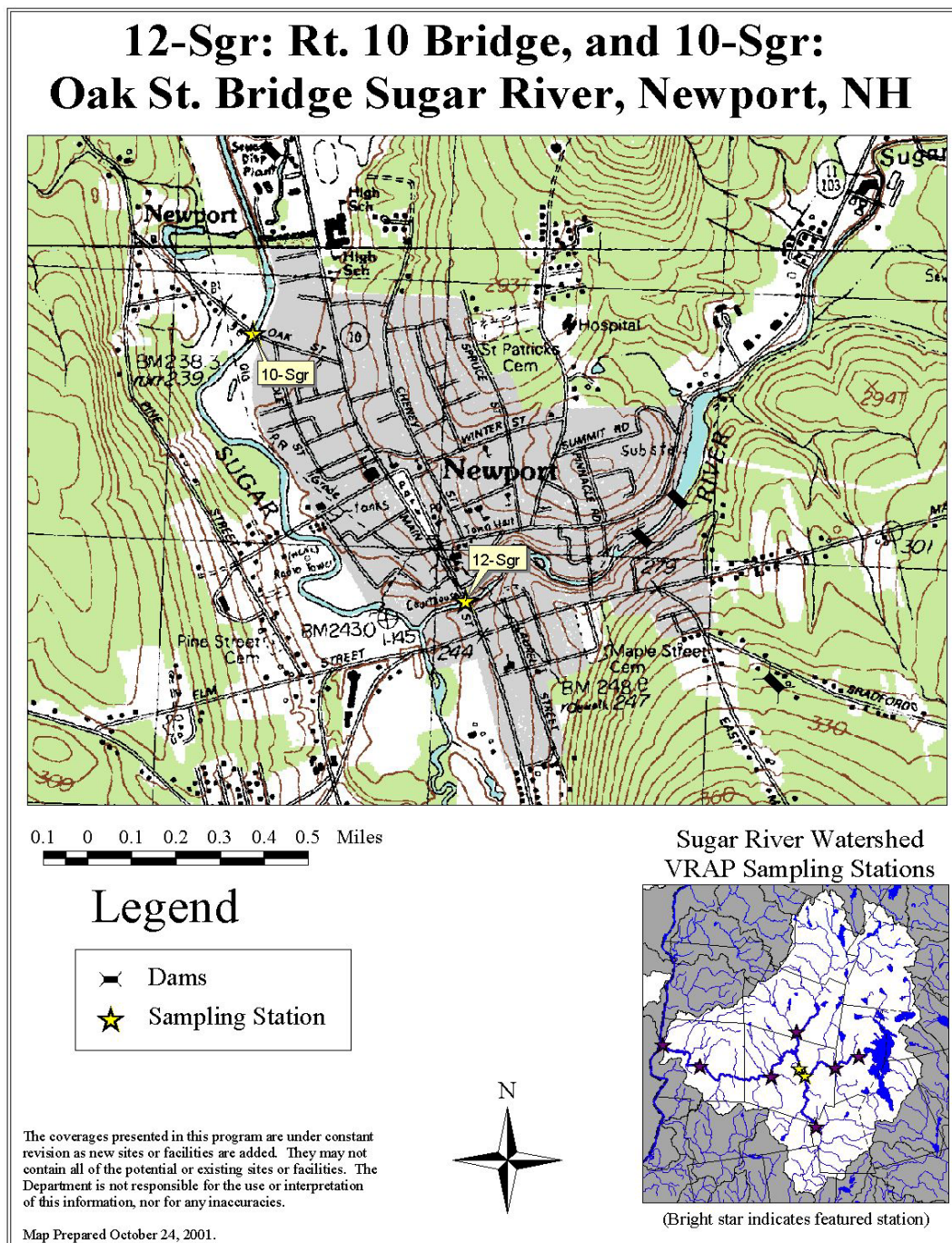


Figure 7. Station location map for 12-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.3.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 3). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Six pH measurements were below the Class B Water Quality Standard.

Table 3. Monitoring Summary: 12-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.6 - 15.1	>5
DO (% sat)	13	13	0	83.1 - 102	>75
pH (Std. Units)	12	12	6	4.04 - 7.05	6.5-8.0
Turbidity (NTUs)	13	13	0	1 - 7.2	<10 above background
Conductivity (µmho/cm)	12	12	0	57.8 - 113.5	NA
<i>E. coli</i> (CTS/100mL)	12	12	0	1 - 198	<406
Total Phosphorus (mg/L)	8	8	0	0.043 - 6.6	NA
NO ₃ (mg/L)	3	3	0	<0.001 - 0.06	NA
Arsenic (mg/L)	6	6	0	<0.001 - <0.05	<0.34
Lead (mg/L)	2	2	0	<0.001 - 0.0023	<0.014
Alkalinity (mg/L)	13	13	0	4.4 - 24	NA
BOD (mg/L)	11	11	0	5 - 9.06	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 8 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

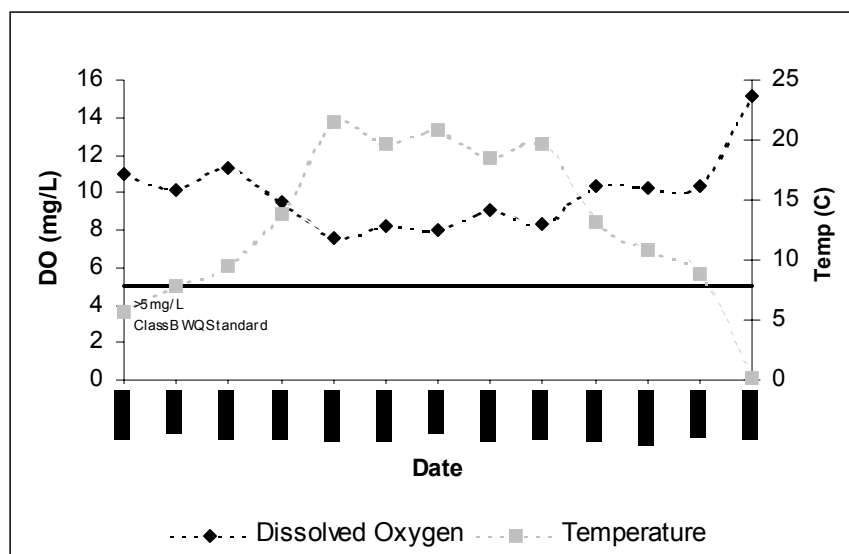


Figure 8. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 12-Sgr. Route 10 Bridge, Newport, NH. VRAP, Year 2000.

pH

The pH at this location, ranging from 4.04 to 7.05, was measured below the state standard range on six of 12 monitoring dates. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

E. coli

E. coli counts were below the standard during the summer of 2000 (Figure 9). Local watershed volunteers collected “instantaneous” samples for *E.coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

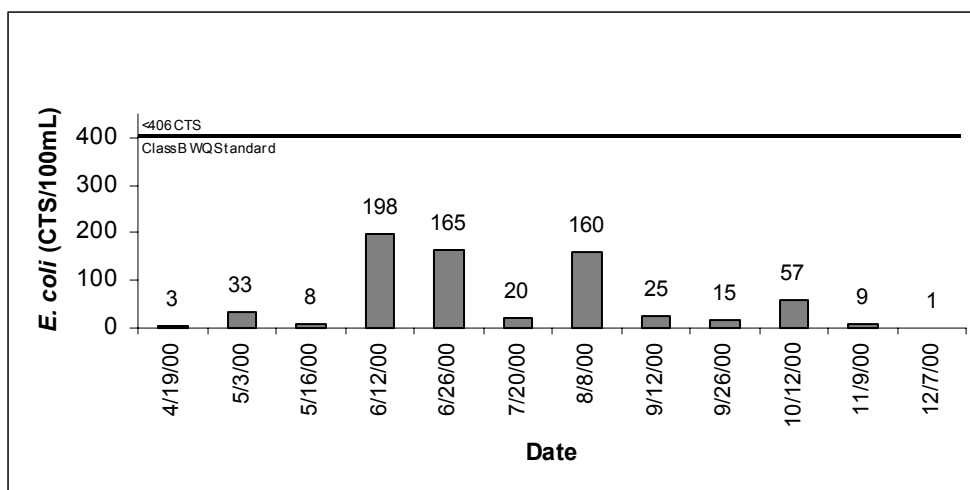


Figure 9. *E. coli* Bacteria Counts. Sugar River at 12-Sgr, Route 10 Bridge, Newport, NH. VRAP, Year 2000.

3.3.3. Recommendations

- *Baseline Monitoring:* Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- *E. coli:* Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is

imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.4. 04-Ssr: Lear Hill Road, Goshen, NH

3.4.1. Station Description

04-Ssr is part of the South Branch of the Sugar River, meeting just downstream of 12-Sgr. The station is located off of a main road in a heavily vegetated area (Figure 10). Houses are scattered upstream of the station and a bog is located upstream to the right. The river at this station is directly below a large rock dam and has a cobble riverbed.

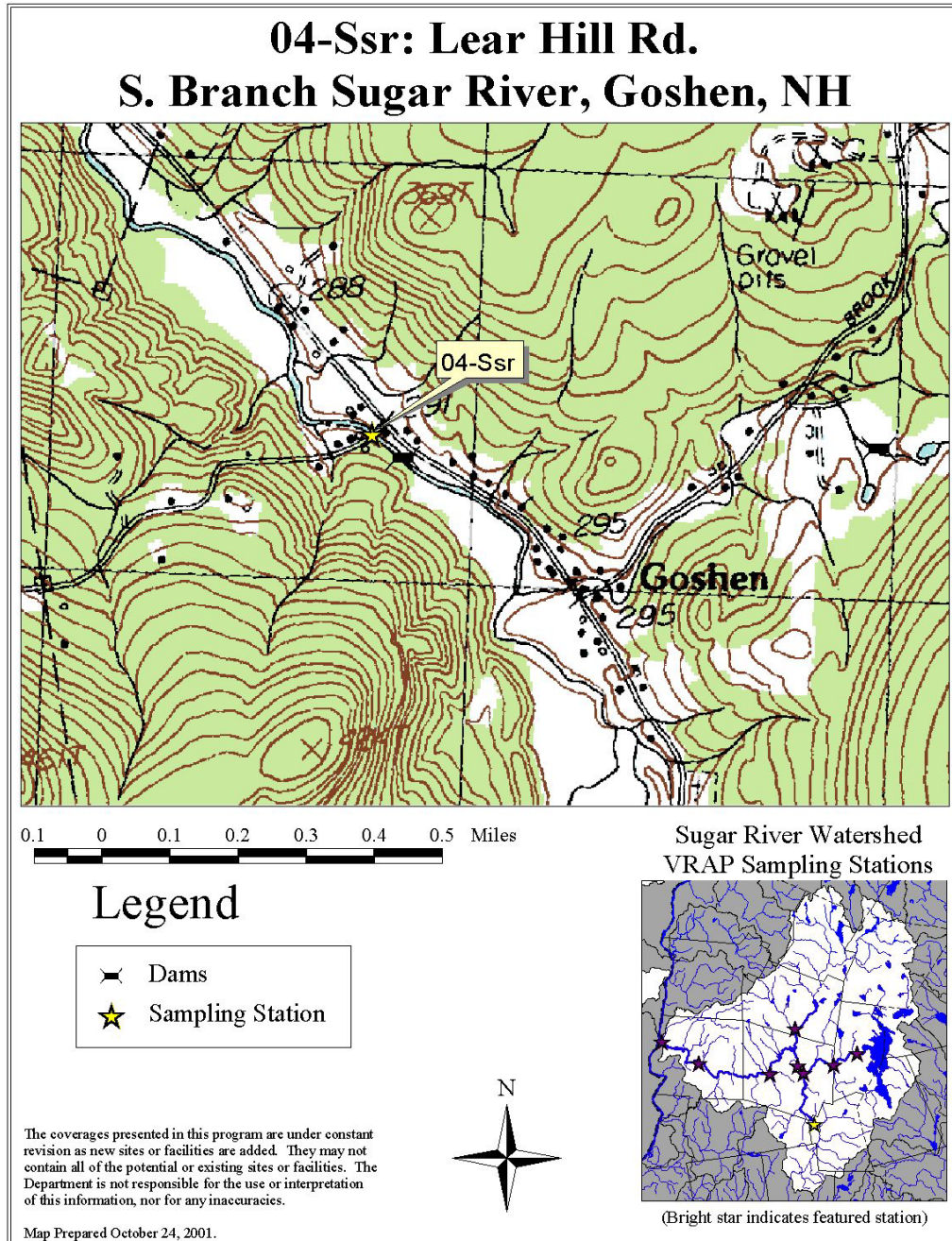


Figure 10. Station location map for 04-Ssr, Sugar River, New Hampshire, VRAP 2000.

3.4.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 4). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Five pH measurements were below the Class B Water Quality Standard.

Table 4. Monitoring Summary: 04-Ssr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	8.25 - 13.25	>5
DO (% sat)	13	13	0	83.5 - 97.2	>75
pH (Std. Units)	12	12	5	4.55 - 7.25	6.5-8.0
Turbidity (NTUs)	13	13	0	0.5 - 5.8	<10 above background
Conductivity (µmho/cm)	12	12	0	26.5 - 96.3	NA
<i>E. coli</i> (CTS/100mL)	12	12	1	2 - 1030	<406
Total Phosphorus (mg/L)	8	8	0	<0.05 - 6.59	NA
NO ₃ (mg/L)	1	1	0	<0.001	NA
Arsenic (mg/L)	5	5	0	<0.005 - <0.05	<0.34
Alkalinity (mg/L)	13	13	0	4.4 - 27	NA
BOD (mg/L)	12	12	0	3.3 - 9.18	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

** Metals standards represent fresh water acute criteria.

Dissolved Oxygen

Figure 11 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

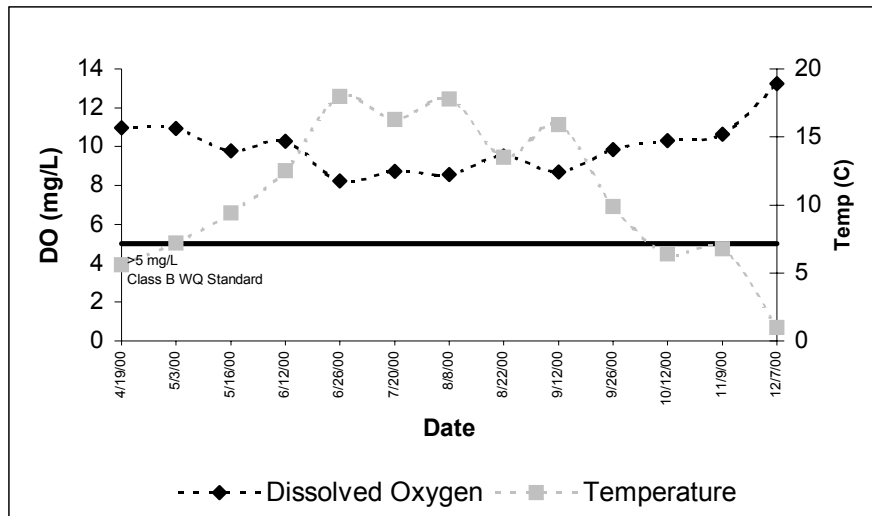


Figure 11. Dissolved Oxygen (DO) Concentration vs. Temperature.
Sugar River at 04-Ssr, Lear Hill Road, Goshen, NH. VRAP, Year 2000.

pH

The pH at this location, ranging from 4.55 to 7.25, was measured below the state standard range on five of 12 monitoring dates. Station conditions are considered together with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

E. coli

Bacteria counts at 04-Ssr were within standards throughout the summer of 2000 with the exception of September 12 (Figure 12). The cause of this spike in bacteria levels is not known, and requires further investigation if high levels reoccur in 2001.

Local watershed volunteers collected “instantaneous” samples for *E.coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

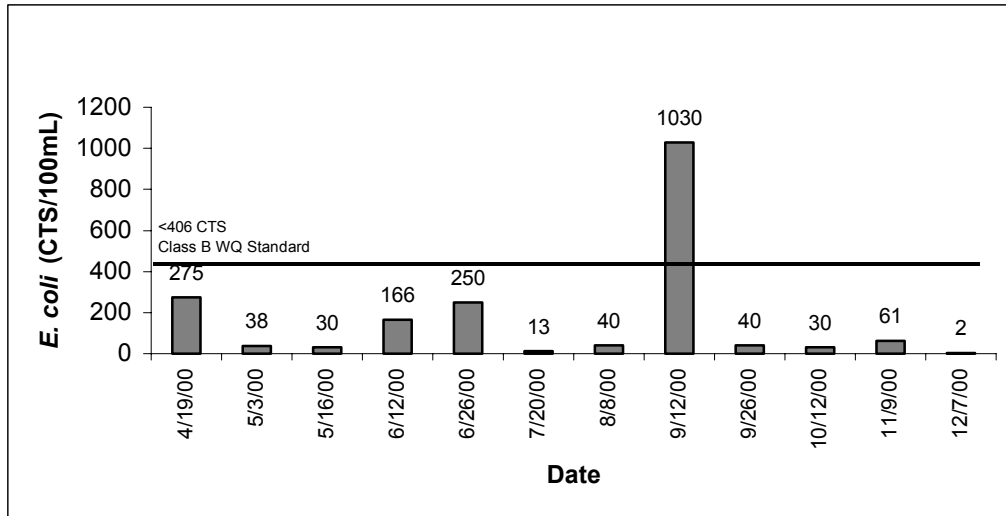


Figure 12. *E. coli* Bacteria Counts. Sugar River at 04-Ssr, Lear Hill Road, Goshen, NH. VRAP, Year 2000.

3.4.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- ***E. coli*:** Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be

coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.5. 10-Sgr: Oak Street Bridge, Newport, NH

3.5.1. Station Description

Downtown Newport is upstream of the station, giving way to the heavily wooded and residential area of 10-Sgr. See Figure 7 in Section 3.3. An old railroad bridge is still in use just upstream of the station. The riverbed is made of cobble and signs of erosion can be seen along the banks.

3.5.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 5). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Six pH measurements were below the Class B Water Quality Standard.

Table 5. Monitoring Summary: 10-Ssr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.79 - 13.94	>5
DO (% sat)	13	13	0	88.2 - 96	>75
pH (Std. Units)	12	12	6	5.72 - 7.04	6.5-8.0
Turbidity (NTUs)	13	13	0	0.61 - 5.9	<10 above background
Conductivity (µmho/cm)	12	12	0	50.8 - 125.1	NA
<i>E. coli</i> (CTS/100mL)	12	12	0	1 - 380	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.54	NA
NO ₃ (mg/L)	2	2	0	<0.001 - 0.28	NA
Arsenic (mg/L)	5	5	0	<0.001 - <0.05	<0.34
Lead (mg/L)	1	1	0	0.0044	<0.014
Alkalinity (mg/L)	13	13	0	0 - 32	NA

BOD (mg/L)	11	11	0	4.28 - 8.54	NA
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*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 13 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

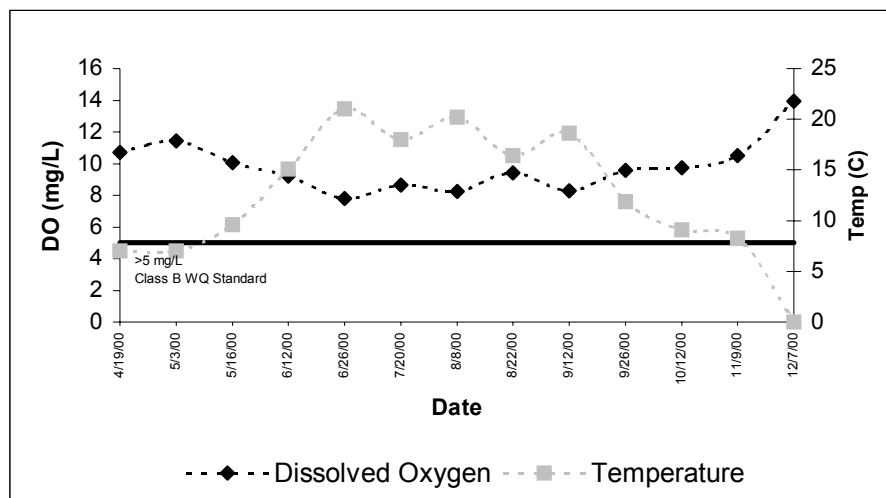


Figure 13. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 10-Sgr, Oak Street Bridge, Newport, NH. VRAP, Year 2000.

pH

The pH at this location, ranging from 5.72 to 7.04, was measured below the state standard range on six of 12 monitoring dates. Low pH appears to be a common theme at each Sugar River station and it is possible that it is a natural occurrence as station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

E. coli

Figure 14 shows the *E. coli* counts during summer 2000. Local watershed volunteers collected “instantaneous” samples for *E. coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

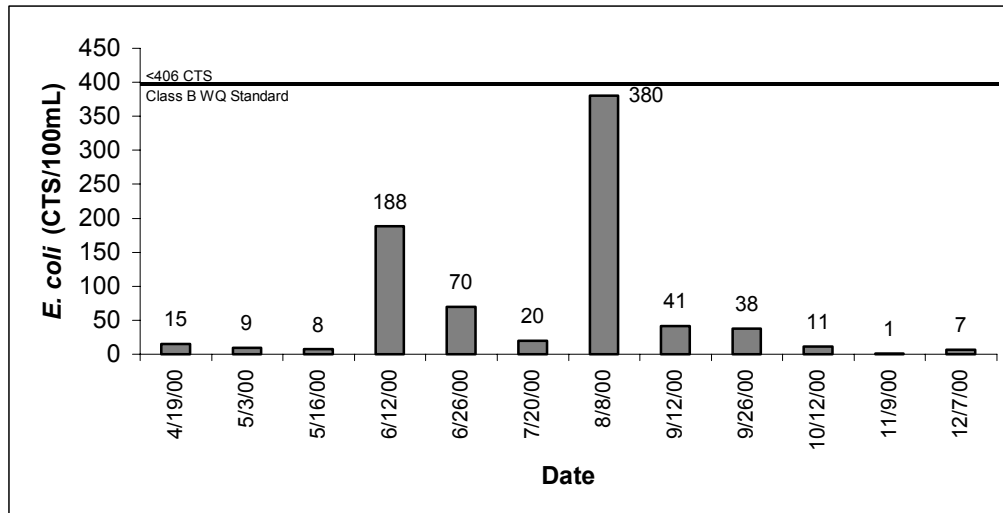


Figure 14. *E. coli* Bacteria Counts. Sugar River at 10-Sgr, Oak Street Bridge, Newport, NH. VRAP, Year 2000.

3.5.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river’s water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- *E. coli*: Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.
- *Dissolved Oxygen*: Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH*: Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

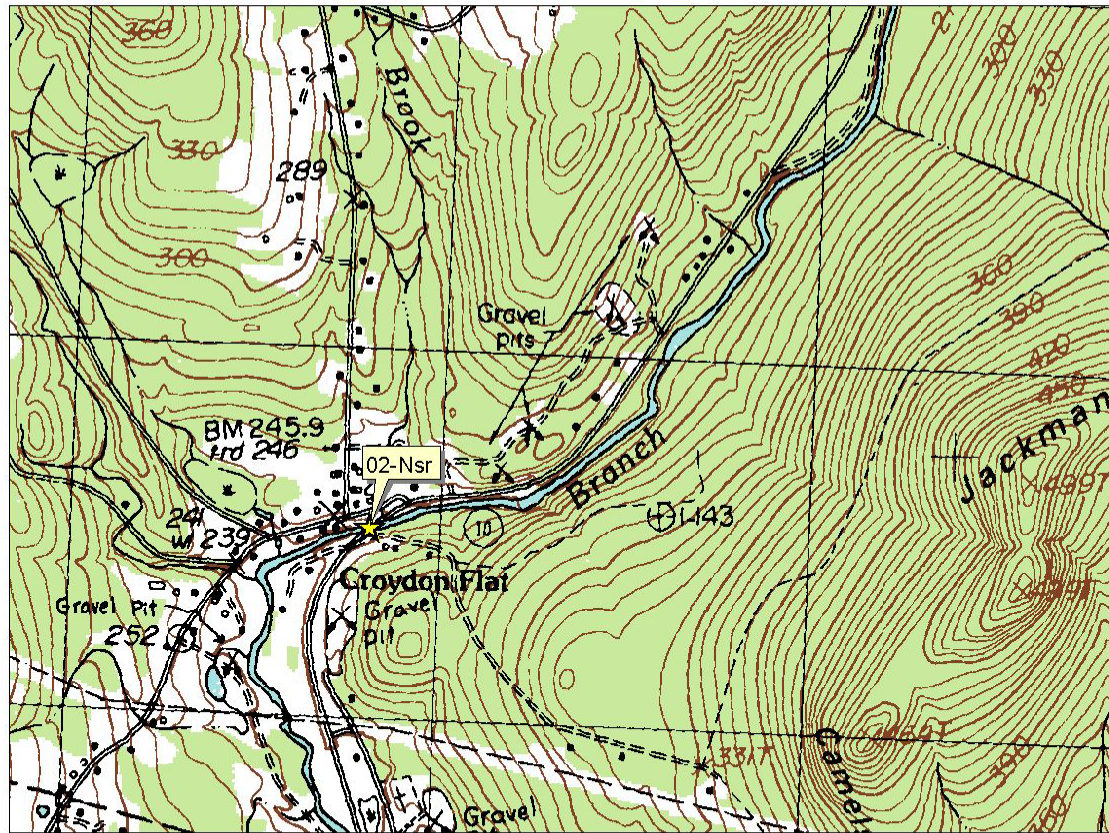
If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.6. 02-Nsr: Route 10 Bridge, Croyden, NH

3.6.1. Station Description

The North Branch joins the Sugar River downstream of 10-Sgr (Figure 15). Upstream of 02-Nsr lies an inaccessible bridge and a large wooded area. An old drainage pipe lies upstream of the station. The river appears heavily eroded and the riverbed is strewn with boulders.

02-Nsr: Rt. 10 Bridge N. Branch Sugar River, Croyden, NH



0.2 0 0.2 0.4 0.6 0.8 Miles

Legend

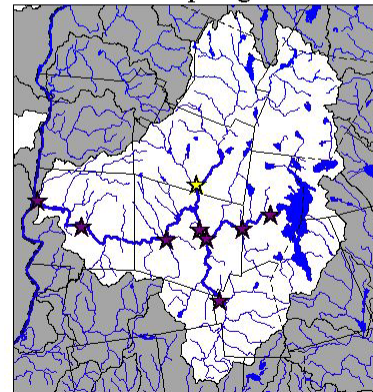
- ✕ Dams
- ★ Sampling Station

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared October 24, 2001.



Sugar River Watershed VRAP Sampling Stations



(Bright star indicates featured station)

Figure 15. Station location map for 02-Nsr, North Branch Sugar River, New Hampshire, VRAP 2000.

3.6.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 6). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Eight pH measurements were below the Class B Water Quality Standard.

Table 6. Monitoring Summary: 02-Nsr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.7 - 14.8	>5
DO (% sat)	13	13	0	87.3 - 102.3	>75
pH (Std. Units)	12	12	8	5.14 - 6.8	6.5-8.0
Turbidity (NTUs)	13	13	0	0 - 2.1	<10 above background
Conductivity (µmho/cm)	12	12	0	12.7 - 131.1	NA
<i>E. coli</i> (CTS/100mL)	12	12	1	2 - 1400	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.48	NA
NO ₃ (mg/L)	1	1	0	<0.001	NA
Arsenic (mg/L)	5	5	0	<0.005 - 0.2	<0.34
Alkalinity (mg/L)	13	13	0	0 - 24	NA
BOD (mg/L)	12	12	0	5.4 - 9.08	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 16 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

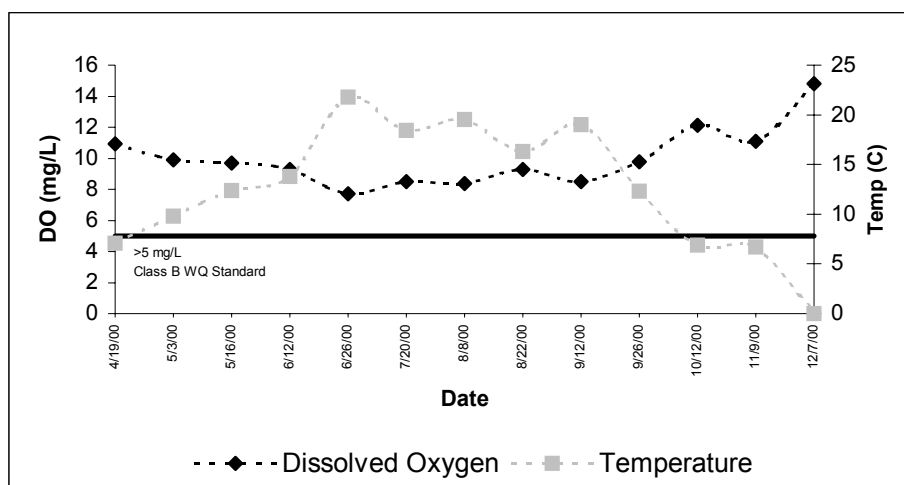


Figure 16. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 02-Nsr, Route 10 Bridge, Croyden, NH. VRAP, Year 2000.

pH

The pH at this location was measured below the state standard range on eight of twelve sampling dates. Low pH appears to be a common theme at each Sugar River station and it is possible that it is a natural occurrence as station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this station is needed.

E. coli

Figure 17 shows the *E. coli* counts during summer 2000. The cause of this spike in bacteria levels is not known, and requires further investigation if high levels reoccur in 2001.

Local watershed volunteers collected “instantaneous” samples for *E.coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

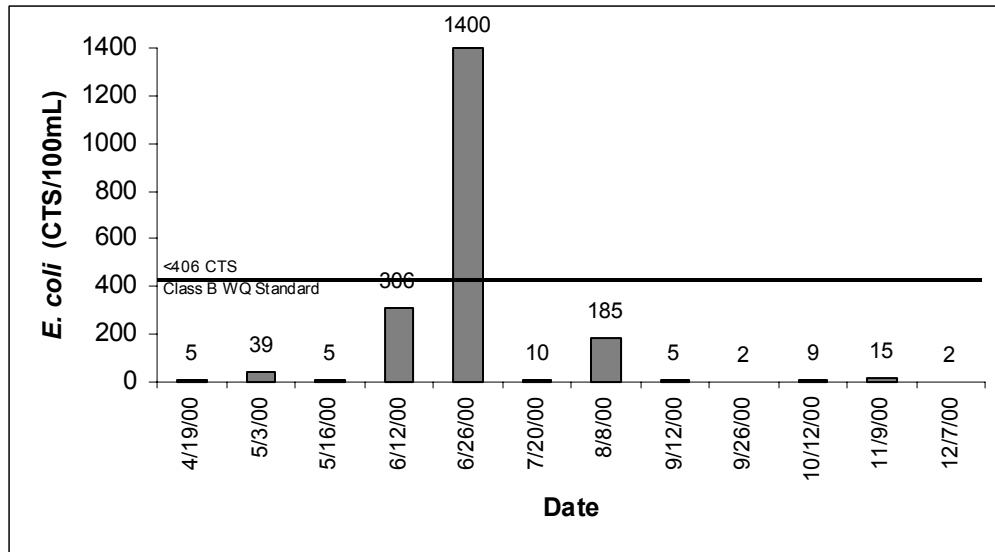


Figure 17. *E. coli* Bacteria Counts. Sugar River at 02-Nsr, Route 10 Bridge, Croyden, NH. VRAP, Year 2000.

3.6.3. Recommendations

- Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- E. coli*:** Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be

coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

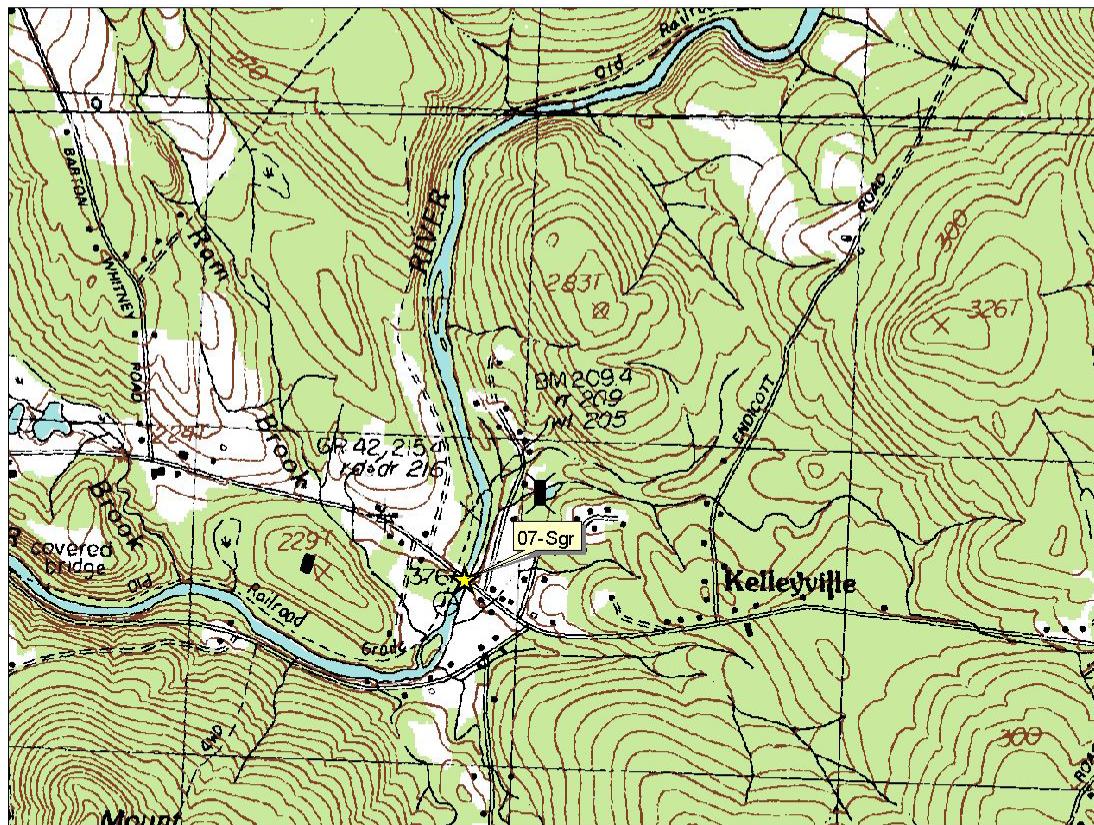
If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

3.7. 07-Sgr: Kellyville Bridge, Newport, NH

3.7.1. Station Description

07-Sgr is located along a main road in a fairly unpopulated area (Figure 18). Just upstream of the station is a “log yard” followed by five miles of woodland. The river shows little sign of erosion and has a cobble riverbed.

07-Sgr: Kellyville Bridge Sugar River, Newport, NH



0.2 0 0.2 0.4 0.6 0.8 1 Miles

Legend

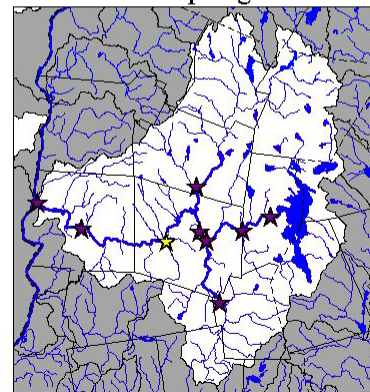
- ✕ Dams
- ★ Sampling Station

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared October 24, 2001.



Sugar River Watershed VRAP Sampling Stations



(Bright star indicates featured station)

Figure 18. Station location map for 07-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.7.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 7). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Four pH measurements were below the Class B Water Quality Standard.

Table 7. Monitoring Summary: 07-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.96 - 15.18	>5
DO (% sat)	13	13	0	85.3 - 105.7	>75
pH (Std. Units)	12	12	4	4.9 - 7.36	6.5-8.0
Turbidity (NTUs)	13	13	0	0.85 - 7.2	<10 above background
Conductivity (µmho/cm)	12	12	0	25.5 - 134.7	NA
<i>E. coli</i> (CTS/100mL)	12	12	1	6 - 680	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.52	NA
NO ₃ (mg/L)	3	3	0	<0.001 - 0.33	NA
Arsenic (mg/L)	7	7	0	<0.001 - 0.1	<0.34
Lead (mg/L)	3	3	0	0.0012 - 0.0029	<0.014
Alkalinity (mg/L)	13	13	0	0 - 43	NA
BOD (mg/L)	12	12	0	2.92 - 9.04	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 19 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are

criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

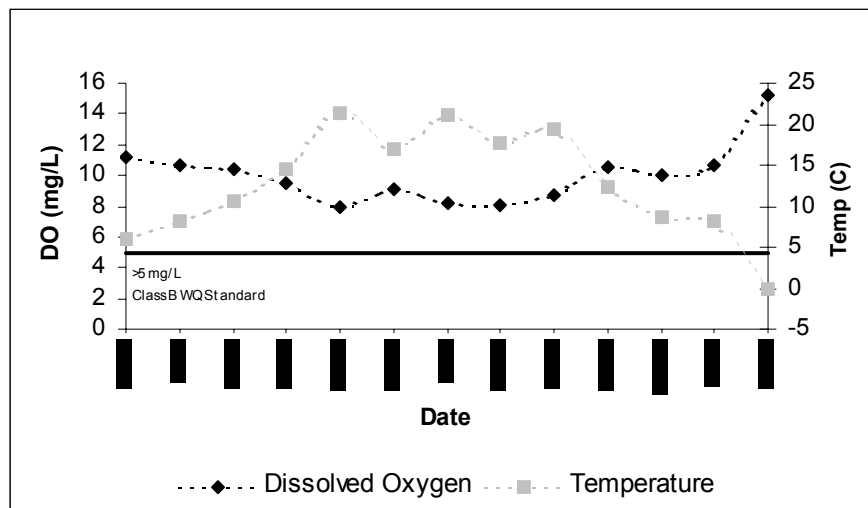


Figure 19. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 07-Sgr, Kellyville Bridge, Newport, NH. VRAP, Year 2000.

pH

The pH at this location was measured below the state standard range on four of twelve sampling dates. Low pH appears to be a common theme at each Sugar River station and it is possible that it is a natural occurrence as station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this station is needed.

E. coli

Figure 20 shows the *E. coli* counts during summer 2000. The cause of this spike in bacteria levels is not known, and requires further investigation if high levels reoccur in 2001.

Local watershed volunteers collected “instantaneous” samples for *E.coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

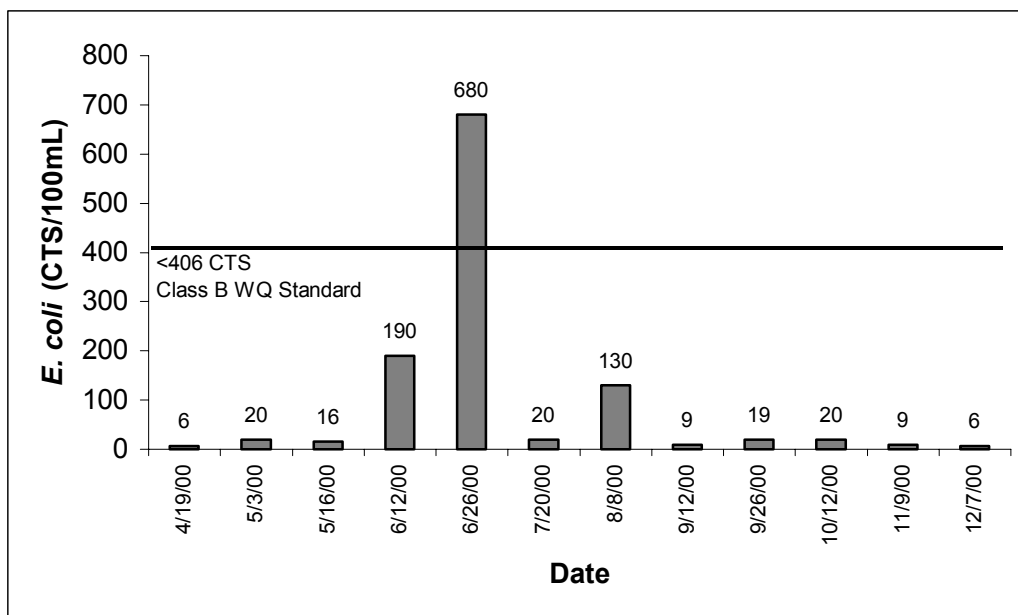


Figure 20. *E. coli* Bacteria Counts. Sugar River at 07-Sgr, Kellyville Bridge, Newport, NH. VRAP, Year 2000.

3.7.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- ***E. coli*:** Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*,

especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible

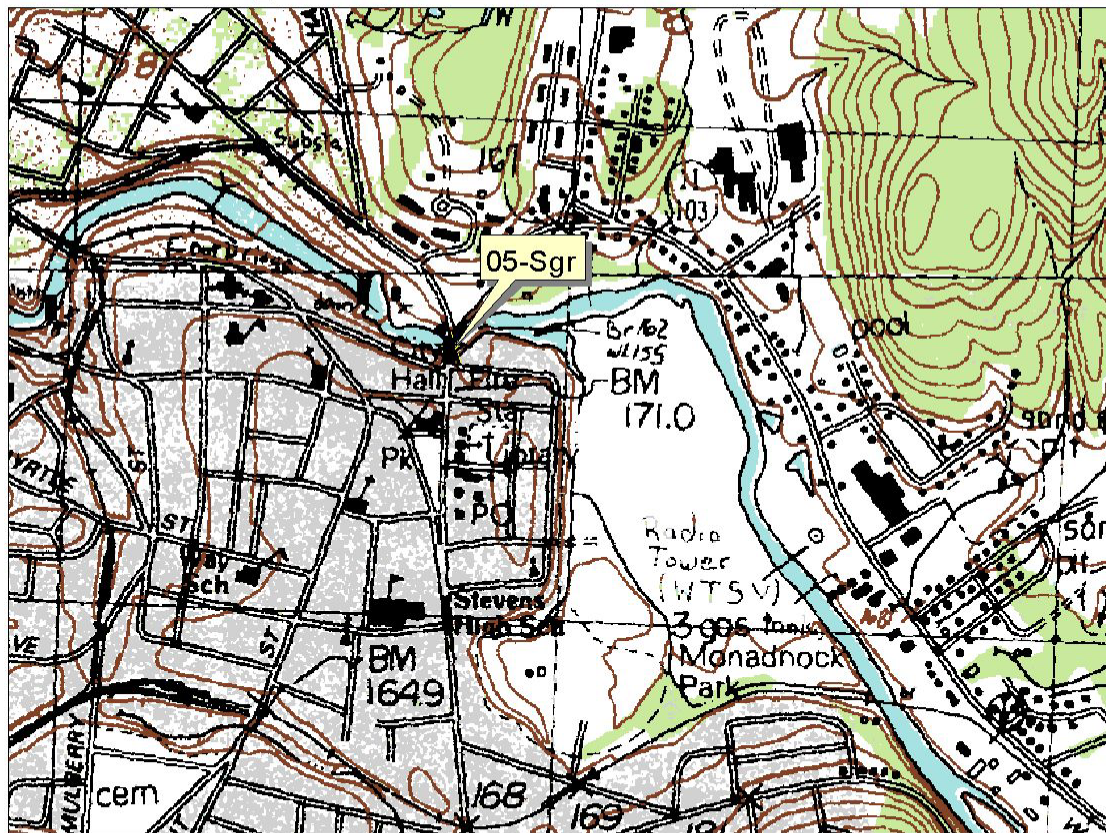
influences, which can be incorporated into the assessment of water quality conditions.

3.8. 05-Sgr: Puksta Bridge, Claremont, NH

3.8.1. Station Description

05-Sgr is directly below a dam in the heart of downtown Claremont (Figure 21). A drainage pipe into the river provides run-off for the surrounding parking lots and busy main roads. There is some dense vegetation along the banks and further upstream is a densely populated suburban area and gas stations. The riverbed at this station is bedrock.

05-Sgr: Puksta Bridge Sugar River, Claremont, NH



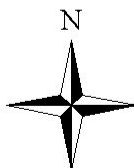
0.1 0 0.1 0.2 0.3 0.4 0.5 Miles

Legend

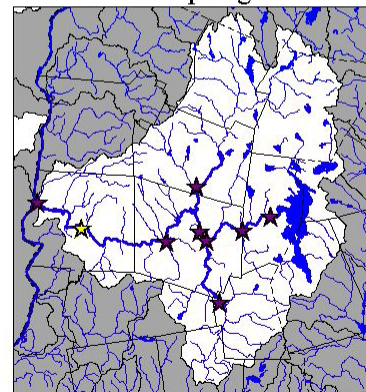
- ✕ Dams
- ★ Sampling Station

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared October 24, 2001.



Sugar River Watershed VRAP Sampling Stations



(Bright star indicates featured station)

Figure 21. Station location map for 05-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.8.2. Results and Discussion

Thirteen measurements for dissolved oxygen (DO) and turbidity, and 12 measurements for pH and conductivity were made in the field using handheld meters (Table 8). Eleven samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Five pH measurements were below the Class B Water Quality Standard.

Table 8. Monitoring Summary: 05-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	13	13	0	7.91 - 14.35	>5
DO (% sat)	13	13	0	83.1 - 97.8	>75
pH (Std. Units)	12	12	5	5 - 7.23	6.5-8.0
Turbidity (NTUs)	13	13	0	0.11 - 7.9	<10 above background
Conductivity (µmho/cm)	12	12	0	58 - 138.9	NA
<i>E. coli</i> (CTS/100mL)	11	11	1	2 - 490	<406
Total Phosphorus (mg/L)	8	8	0	<0.05 - 6.31	NA
NO ₃ (mg/L)	5	5	0	<0.001 - 0.31	NA
Arsenic (mg/L)	8	8	0	<0.001 - 0.2	<0.34
Alkalinity (mg/L)	12	12	0	5.2 - 27	NA
BOD (mg/L)	11	11	0	5 - 8.85	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 22 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

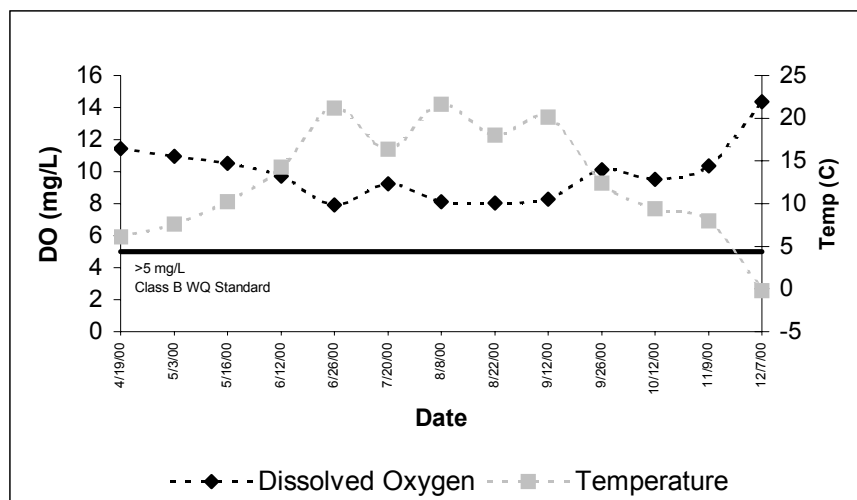


Figure 22. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 05-Sgr, Puksta Bridge, Claremont, NH. VRAP, Year 2000.

pH

The pH at this location was measured below the state standard range on five of twelve sampling dates. The number of low pH readings along the length of the Sugar River may indicate that these levels are natural. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Additional information about factors influencing pH levels at this station is needed.

E. coli

Figure 23 shows the *E. coli* counts during summer 2000. The cause of this spike in bacteria levels is not known, and requires further investigation if high levels reoccur in 2001.

Local watershed volunteers collected “instantaneous” samples for *E.coli* bacteria analysis. The frequency of collection (less than three samples collected within a sixty-day period) places these measurements in the instantaneous category. This means that the sample results with >406 CTS/100mL indicate potentially elevated levels of *E. coli*. The area requires additional samples in order to verify the presence and persistence of elevated *E. coli* levels.

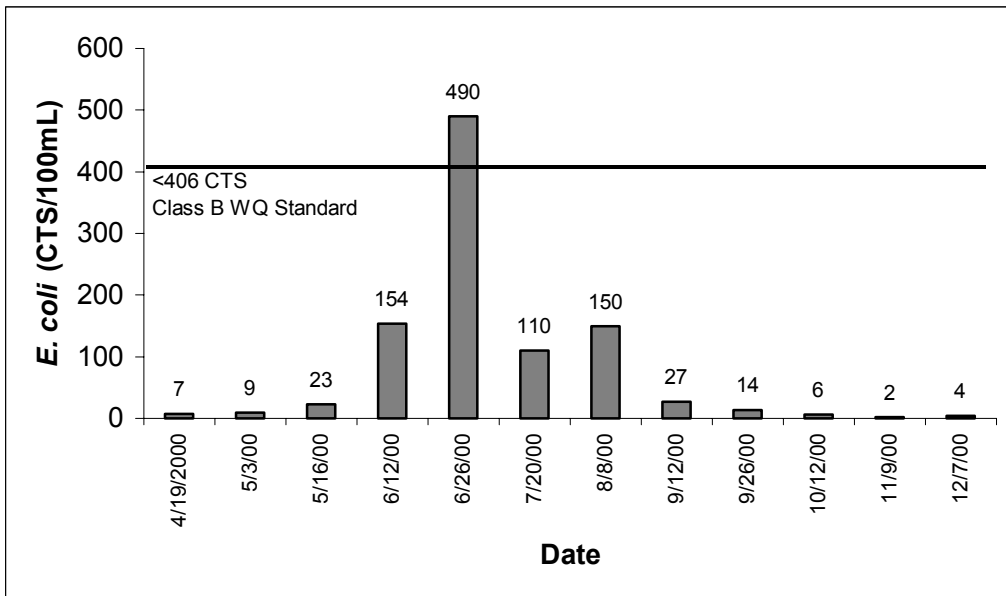


Figure 23. *E. coli* Bacteria Counts. Sugar River at 05-Sgr, Puksta Bridge, Claremont, NH. VRAP, Year 2000.

3.8.3. Recommendations

- **Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- ***E. coli*:** Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least

three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible

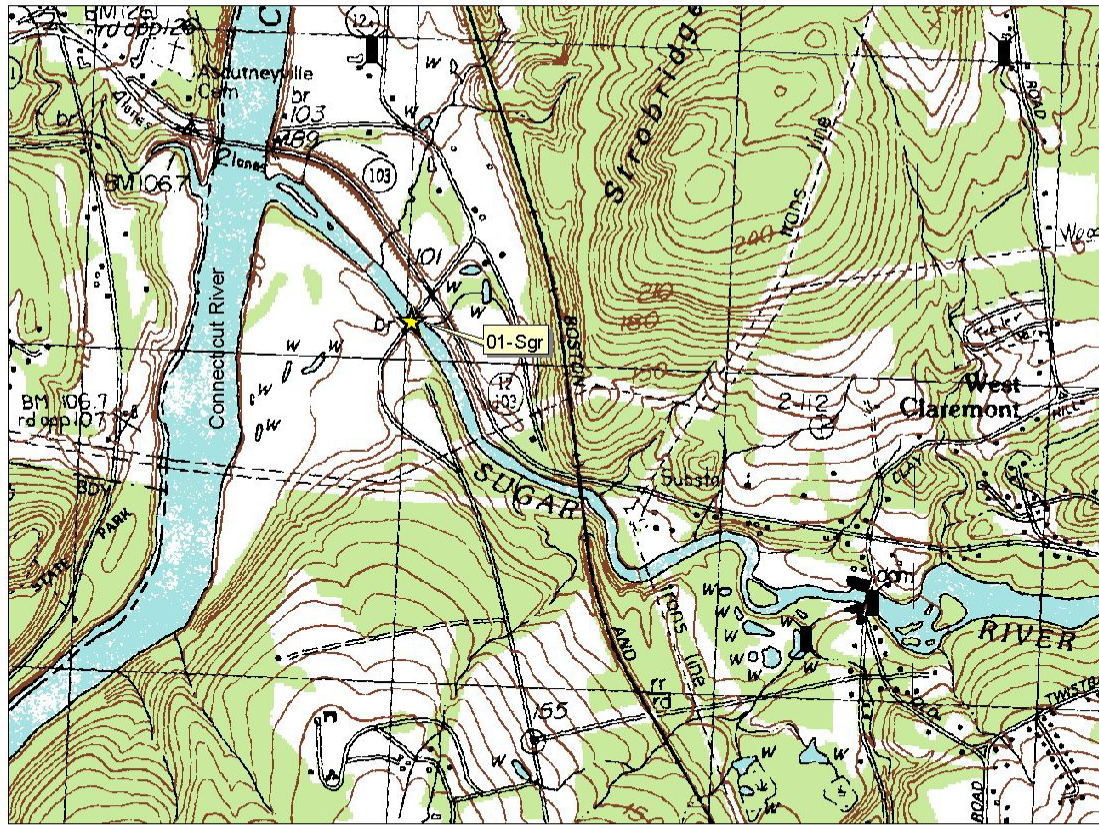
influences, which can be incorporated into the assessment of water quality conditions.

3.9. 01-Sgr: Lottery Bridge, Claremont, NH

3.9.1. Station Description

01-Sgr is located in downtown Claremont (Figure 24). Upstream of the station are major roads, fields, a paper mill and a wastewater treatment facility. There is dense vegetation along the riverbanks only and the riverbed is a mix of silt and cobble.

01-Sgr: Lottery Bridge Sugar River, Claremont, NH



0.2 0 0.2 0.4 0.6 0.8 1 Miles

Legend

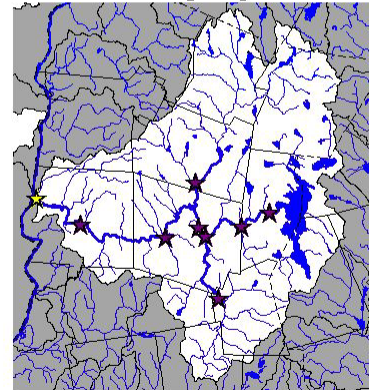
- ✕ Dams
- ★ Sampling Station

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared October 24, 2001.



Sugar River Watershed VRAP Sampling Stations



(Bright star indicates featured station)

Figure 24. Station location map for 01-Sgr, Sugar River, New Hampshire, VRAP 2000.

3.9.2. Results and Discussion

Twelve measurements for dissolved oxygen (DO), pH, turbidity, and conductivity were made in the field using handheld meters (Table 9). Twelve samples were collected for (*E. coli* bacteria), and a variable number of samples were collected for other parameters for laboratory analysis. All measurements and samples met the Quality Assurance and Quality Control (QA/QC) requirements. Five pH measurements were below the Class B Water Quality Standard.

Table 9. Monitoring Summary: 01-Sgr. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards*
DO (mg/L)	12	12	0	7.59 - 11.92	>5
DO (% sat)	12	12	0	82.6 - 98.9	>75
pH (Std. Units)	12	12	5	5.18 - 7.07	6.5-8.0
Turbidity (NTUs)	12	12	0	0.83 - 5.9	<10 above background
Conductivity (µmho/cm)	12	12	0	61.0 - 170.2	NA
<i>E. coli</i> CTS/100mL	12	12	0	3 - 326	<406
Total Phosphorus (mg/L)	8	8	0	<0.034 - 6.45	NA
NO ₃ (mg/L)	3	3	0	0.13 - 0.43	NA
Arsenic (mg/L)	7	7	0	<0.001 - <0.05	<0.34
Lead (mg/L)	3	3	0	0.0015 - <0.001	<0.014
Alkalinity (mg/L)	13	13	0	6.8 - 38	NA
BOD (mg/L)	12	12	0	2.4 - 8.66	NA

*Abbreviated standard values have been used in this table for quick reference. Please see Env-Ws 1700 and RSA 485-A:8 for complete Surface Water Quality Regulations.

Dissolved Oxygen

Figure 25 shows dissolved oxygen concentration and water temperature during 2000. Levels of DO sustained above the standards are considered adequate for wildlife populations and other desirable water quality conditions. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are

criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional sampling is necessary.

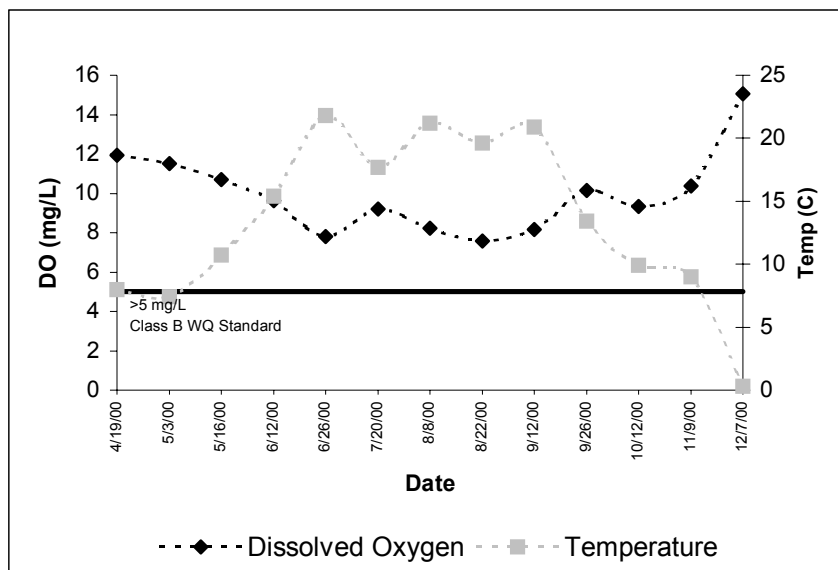


Figure 25. Dissolved Oxygen (DO) Concentration vs. Temperature. Sugar River at 01-Sgr, Lottery Bridge, Claremont, NH. VRAP, Year 2000.

pH

The pH at this location was measured below the state standard range on five of twelve sampling dates. The number of low pH readings along the length of the Sugar River may indicate that these levels are natural. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Additional information about factors influencing pH levels at this station is needed.

E. coli

E. coli levels were all below the standard. (see Figure 26) The geometric mean standard was exceeded over one sixty-day period. The peak in *E. coli* levels does not follow the same trend of June 26 as the other stations do. This suggests another source of contamination along this stretch of the Sugar River. On June 12, 2000, rain may have increased run-off from the wastewater treatment facility upstream of the station, increasing *E. coli* levels.

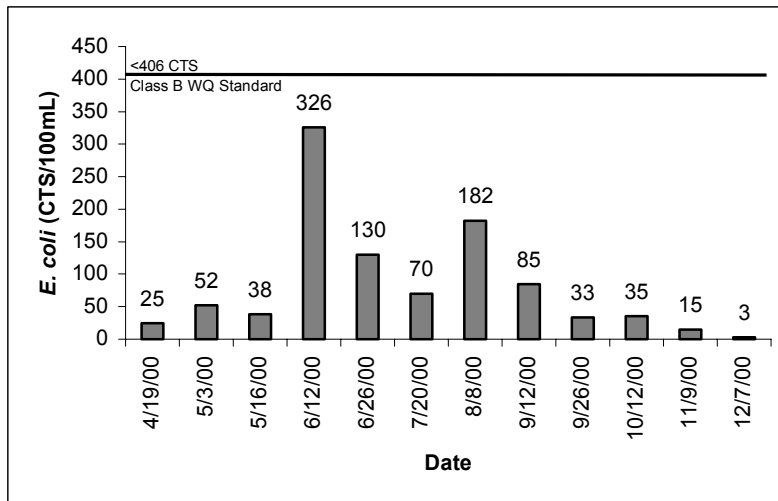


Figure 26. *E. coli* Bacteria Counts. Sugar River at 01-Sgr, Lottery Bridge, Claremont, NH. VRAP, Year 2000.

3.9.3. Recommendations

- *Baseline Monitoring:* Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all conditions, and to confirm that this area of the river attains standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES as well as local decision makers.

VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report.

Special attention should be given to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with water quality data. A complete discussion of water quality conditions cannot be made without a record of weather conditions.

- *E. coli:* Continued *E. coli* sampling at this location is encouraged. The sampling and analyses contributed by volunteers and laboratory facilities has been an important preliminary investigation tool for gathering information about *E. coli* conditions in the Sugar River watershed. *E. coli* can influence recreational and other potential water quality aspects. Therefore it is important to monitor *E. coli*, especially where swimming might be expected. If possible, collecting at least three samples during a sixty-day period is recommended, and should be coordinated with DES assessment activities. For data interpretation purposes, it

is imperative that weather conditions are provided to VRAP along with the water quality data.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process is not completed in the short term because of the variability of water quality and the organization of volunteers involved. Volunteers may choose to plan one of the following phases each year, and contribute their observations and results to DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine patterns of runoff and flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetland drainage upstream from the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information about drainage patterns in the immediate watershed area.

Phase II:

If wetland drainage is present, the next step is to sample upstream from the wetland's influence, if possible. Volunteers sampling upstream from a wetland may discover that pH is within the standard range, and that it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from an influencing wetland it is possible that there is another source of acidity, and volunteer investigations should continue upstream. Continued investigations will help document possible influences, which can be incorporated into the assessment of water quality conditions.

Appendix A:
List of Stations

Appendix B:

Raw Data Tables

Appendix C:

Water Quality Parameters and Surface Water Quality Standards

Appendix D:
River Graphs

Appendix E:
Field Sampling Protocols